Improving Patient Outcomes through Use of a Stroke Navigator Program

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Abstract

BACKGROUND: Stroke is a serious condition associated with significant morbidity and mortality. Of the 800,000 strokes that occur in the United States annually, one quarter can be described as recurrent events. Timeliness of care and patient education are considered critical tenets of stroke management. These interventions limit neuronal loss and prepare the patient to adopt lifestyle changes that prevent recurrent stroke. Several previous studies demonstrate that the use of patient navigator programs can improve clinical outcomes in this patient population. **METHODS:** A stroke navigator quality improvement program was designed and deployed at a stroke center in the American Southwest. During the 3-month study, patients diagnosed with stroke were enrolled by means of implied consent (n=52). Subjects were followed from emergency department presentation to discharge. Interventions aimed to reduce times from door to computed tomography (CT), door to alteplase, and door to thrombectomy. Patients were also provided education, emotional support, and case management. Positive response was defined as reduction in time taken to achieve core measures when compared with baseline institutional data. **RESULTS:** Two-tailed Wilcoxon signed rank tests were utilized to compare two large data sets: baseline door to CT, alteplase, and thrombectomy mean times for three months preceding the intervention to the three month period during which the intervention was deployed. No statistical significance was demonstrated. Next, the same test was used to compare baseline CT time data to the smaller group of patients that were treated by the stroke navigator. This showed that the stroke navigator yielded significant reduction in door to CT times when compared to baseline institutional performance (p=0.015). **CONCLUSION:** In concurrence with previous research, the stroke navigator program was successful in improving the quality of stroke care, notably during the acute phase when expedited computed tomography is needed to prevent neuronal loss.

Further research is needed to determine if the intervention could improve door to alteplase and thrombectomy times as well as prevent stroke readmissions.

Keywords: Ischemic Stroke, Hemorrhagic Stroke, CVA, Navigation, Stroke Navigator

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Background and Significance

Stroke is the fifth leading cause of death in the United States with a prevalence of 2.6% in individuals under the age of twenty (Guzik & Bushnell, 2017). While all strokes have the potential to yield devastating consequences, data suggests that secondary stroke is linked with increased length of hospital stays, increased mortality rates, and greater extent of debilitation (Oza et al., 2017). Unfortunately, Oza et al. (2017) assert that one quarter of all national stroke incidence can be described as preventable recurrent events. Many individuals diagnosed with stroke are left with permanent neurological deficits that negatively impact functional capacity and quality of life. In addition, from an economic standpoint, this diagnosis is a costly phenomenon. Societal spending related to both direct and indirect costs of stroke care was estimated to be just over $105 billion in 2012 and is expected to increase to $240.7 billion by the year 2030 (Stuntz et al., 2017). This causes further insult to an already strained health system and urges improved performance related to the diagnosis of stroke.

Globally, stroke is the second leading cause of death worldwide with an estimated 17 million cases occurring annually (Feigin & Krishnamurthi, 2015). While stroke incidence has declined in developed, high-income countries over the past decades, both incidence and prevalence have been on the steady increase in low to mid-income countries as a result of health disparity. Regarding recurrent stroke, global statistics are showing signs of improvement. In 2001, the cumulative incidence of recurrent stroke was 15% whereas incidence of the same phenomenon decreased to 12% in 2010 (Bergstrom et al., 2017). This reduction is attributed to various efforts aimed at risk reduction and secondary stroke prevention interventions.

The State of New Mexico has published interesting data regarding mortality rates associated with stroke. Between the years of 2004 and 2015, the state demonstrated death rates below the national average and well-aligned with the Healthy People 2020 initiative goals. However, during the last year in which data was published, 2016, New Mexico saw an increase in stroke-related mortality rates. In addition, the most recent data shows a consistent national decline in stroke mortality while New Mexico did not (New Mexico Department of Health [NMDOH], 2018). It is important to note that actual incidence and prevalence of stroke in New Mexico is not reported as the state has only recently developed a database to collect and trend this data.

While it is evident that improving comprehensive stroke management would greatly benefit society in both public health and economic domains, meeting this goal is difficult due to the of the complexity of inpatient stroke care. First, hospitals must ensure that patients receive the right interventions at the right time early in the hospital course to prevent neuronal death associated with ischemic stroke. This appropriate, timely delivery of indicated tests, medications, and invasive procedures requires a great degree of coordination and demands the utilization of a team approach. Second, prevention of recurrent stroke depends largely on the expert delivery of education to ensure that the patient will be able to perform self-care after hospital discharge. This includes meticulous management of existing chronic diseases, most notably hypertension, diabetes, hyperlipidemia, heart disease, and obstructive sleep apnea. It also includes making significant lifestyle changes such as smoking cessation, reduction of alcohol intake, and increasing physical activity (Oza et al., 2017). Unfortunately, a body of emerging qualitative data reveals that the current methods of providing stroke education to inpatients is falling short of meeting intended goals. A common complaint by former patients is that they lacked the ability to

understand discharge instructions upon returning home and did not know how to access ongoing care services or community support infrastructures. Most of these patients endorse receiving education solely through the provision of a written pamphlet containing information that was difficult to comprehend (Denham et al., 2019). Other evidence indicates that although nurses and other hospital staff understand the dire need to educate stroke patients and their families, obstacles frequently prevent the provision of proper education. These obstacles most commonly include being unable to allot the time for patient education delivery and lack of administrative support as evidenced by written supplemental stroke information being unavailable or outdated within stroke facilities (Roy et al., 2015). Alarmingly, in stroke patients discharged from the acute care setting, 73.8% of these individuals had not had their needs met regarding stroke education and knowledge, more than half did not know how to prevent stroke, and nearly a quarter did not know what a stroke was (Hughes et al., 2020). Hughes et al. (2020) make the important assertion that such knowledge deficits have been associated with increased disability, decreased quality of life, and lower levels of community integration. They would also serve to increase the risk of stroke recurrence.

Further complexity attributed by the current Covid-19 pandemic must also be acknowledged. Several factors are currently at play. First, patients with onset of classic stroke symptoms are delaying presentation to emergency departments due to fear of viral transmission or due to social distancing practices which prevent contacts of the patient from noticing symptoms promptly. Secondly, the significant additional strain placed upon existing emergency systems has resulted in disorganized care and failure to adhere to usual protocols and time-sensitive metrics typically utilized with stroke patients. Lastly, new visitation policies in place prevent the presence of family members who are often essential to provide critical health history

and medical consents. This leads to catastrophic delays in the provision of life saving medications or surgical interventions (Dafer et al., 2020). The importance of timely stroke care cannot be under emphasized considering that for every minute that an ischemic stroke is left untreated, approximately 1.9 million neurons die (Saver, 2006). This realization has prompted the American Heart Association (AHA) to provide guidelines that dictate the length of time it should take a hospital to procure critical interventions. The current standard is to obtain computed tomography (CT) within 25 minutes of patient arrival, deliver alteplase within 45 minutes of arrival, and initiate mechanical thrombectomy within 75 minutes of arrival to the emergency department (ED) (American Heart Association [AHA], 2019).

A critical access hospital and primary stroke center in the New Mexico was examined and identified as being unable to deliver adequate inpatient services to the approximate 600 stroke patients it sees on an annual basis. Over the past two years, systemic changes including the institution's loss of its neurosurgical residency accreditation have culminated in unprecedented staff turnover, loss of experienced neurocritical care nurses, and unsafe staffing ratios. A topic that frequently emerges in staff meetings is that nurses are having difficulty budgeting time for stroke education and frequently omit this action from their care plans. If able to provide education, they feel clinically unprepared to meet the patients' educational needs. Subsequently, significant knowledge deficit is apparent upon discharge as patients often cannot verbalize what their diagnosis is or how they should care for themselves post-discharge. Additional internal evidence reveals institutional non-compliance with time-sensitive Joint Commission stroke mandates, inability to deliver appropriate care management and educational resources to prevent recurrent stroke, inability to link individuals with stroke to pertinent community resources that would serve to improve outcomes, and considerable delays related to

profound system fragmentation in the setting of the Covid-19 pandemic. These findings demonstrate the need for an intervention that would simultaneously improve timeliness of stroke care while also improving education delivery.

The preceding discussion influenced the development of the following PICOT question: In hospitalized stroke patients (P), would the adoption of a nurse navigator program (I) impact patient education and acute care delivery (O) when compared to standard practice (C) over the duration of a twelve-week period (T)? Taking this into consideration, the purpose of this paper is to explore the effects of a stroke navigator program on improving hospital performance and key patient outcomes in the target population.

Evidence Synthesis

Some hospitals systems have adopted nurse navigator programs to better adhere to stroke compliance measures as well as to improve the quality of care delivered to this patient population. This is an emerging nursing role in which the nurse navigator is responsible for delivering patient education, psychosocial support, and smoothing care transitions. The usual approach is for the navigator to initiate contact during the acute period of illness in the hospital setting and continue contact with the patient as he or she is discharged into the community. This allows for continuity of care and support that cannot be delivered by staff nurses and physicians alone. Nurse navigators have demonstrated that their work results in increased adherence to medication regimens, increased attendance to follow up appointments, improved quality of life, improved satisfaction with care, and reduced 30-day hospital admission (Deen et al., 2018). Utilization of nurse navigators could not only decrease incidence of stroke recurrence but also serve to reduce some of the health disparity seen in stroke by better linking those with obstacles to receiving care to community resources. This promising data influenced an exhaustive

literature review and, ultimately, the development of the stroke navigator quality improvement (QI) project.

Exhaustive searches were employed in three separate research databases. Selected databases included the Cumulative Index of Nursing and Allied Health (CINAHL), PubMed, and the Cochrane Database based on the rationale that all three have a dedication to scientific rigor and evidence-based practice in health care. Key search terms were chosen to reflect all aspects of the PICOT question and included *stroke patients, post-stroke, stroke survivors, chronic disease, chronic conditions, nurse navigator, nurse coordinator, patient navigation, patient navigator, patient education,* and *improve outcomes.* All terms were connected using Boolean phrases to ensure that the search captured research featuring the topic of patient navigation regardless of what term was used to describe this emerging role. In addition, although stroke patients are the patient population of focus, the concept of patient navigation is new to the field of neurosciences. As a result, it was decided that a relevant search should include the impact of this intervention on patients suffering from any chronic disease or long-term condition. Filters were then applied, narrowing the search to include only peer-reviewed articles published within the past five years, and to omit any articles published in a language other than English. This strategy yielded manageable quantities of high-quality articles from each database.

All results yielded from the three databases were evaluated for validity, reliability, and relevance to clinical practice. Inclusion criteria included any nurse navigator program intervention that aimed to improve patient outcomes or assess the impact that such a program would have on the its research subjects. Articles were included whether or not the intervention yielded positive results to avoid personal bias in presenting data. In addition, articles deploying a navigator intervention to subjects suffering from any chronic disease were included even though

stroke is the primary focus of the current research. Because the proposed quality improvement project focuses only on adult patients, any article featuring a pediatric patient population was excluded. The searches described yielded several meta analyses and systematic reviews. Because there was overlap in the studies being analyzed in these publications, in order to avoid redundancy, all were excluded expect for two high-quality, recent publications. After exclusions were made, the remaining articles underwent critical appraisal and only the ten highest-quality research articles were retained. This final selection included one systematic review, one meta-analysis, two randomized controlled trials, four cohort studies, one case series study, and one qualitative study. The qualitative study was retained as it was deemed important to understand the subjective experience of individuals impacted by a patient navigator program.

The ten articles retained for appraisal consisted of varying levels of evidence ranging from high quality to relatively low quality (see Appendix A, Table 1). While the qualitative study utilized was not considered the highest level of evidence, it produced rich data revealing the subjective impact of a patient navigator (PN) intervention on individuals with complex needs post hospitalization (see Appendix A, Table 2). Studies were carefully reviewed to determine sources of funding and to identify the presence of bias that could potentially skew results. Five of ten studies provided funding information and no potential conflicts of interest were identified. Possible publication bias was identified in only one study while no overt or inferred bias was evident in any of the remaining studies. The studies disseminated the patient navigator (PN) intervention in a variety of settings ranging from hospital units to community-based clinics. In some cases, the intervention followed subjects from the inpatient setting to the community post discharge to assess the effect of the intervention on care transitions. Appropriate sample size was difficult to deduce secondary to the fact that power analyses were not routinely performed.

A fair degree of homogeneity was identified when comparing the interventions deployed in all ten studies. While all studies utilized patient navigation as an independent variable, there were some subtle differences in the exact nature of the intervention (see Appendix A, Table 3). This was deemed acceptable considering that the target populations varied in terms of diagnosis. While the intervention was specifically aimed at stroke patients in two studies, other studies featured subjects with different disease processes such as heart disease or cancer. In some cases, the precise characteristics of the navigator intervention could not be appraised as they were not thoroughly described. This can be viewed as one area of weakness consistent throughout the body of evidence. Meanwhile, the most common dependent variables studies were the effects of patient navigation on hospital readmissions, emergency room usage, adherence to care regimens post discharge, and appropriate utilization of aftercare services (see Appendix A, Table 3).

All ten studies utilized sound analytical methodology in yielding published data and similar results were appreciated across all ten studies. The research unanimously demonstrates statistically significant effects of a PN intervention, most notably reduction in emergency department visits and all-cause hospitalizations within thirty days as well as increased adherence to post-discharge self-care interventions and attendance of follow up clinic visits. Only two studies quantified the magnitude of cost savings that can be appreciated through use of this intervention. It can be inferred that the PN programs featured in the studies yielded positive outcomes by delivering improved transitional care, ongoing support, and improved patient education. However, because some studies utilized lay navigators while others used nurses or multidisciplinary teams to deliver the intervention, it is difficult to deduce which PN design is most effective. While the appraised studies were of high quality and demonstrated high levels of validity and reliability, there is some question of applicability across patient populations.

Because the research generally featured underserved or vulnerable patients with chronic or complex disease, one cannot say with certainty how the PN navigator intervention might affect stroke patients of varying socioeconomic statuses.

Because the current Covid-19 pandemic added significant complexity to existing healthcare infrastructures, it was deemed important to investigate whether the nurse navigator role could also be utilized to improve the timeliness and coordination of care that occurs when stroke patients arrive in the Emergency Department (ED). Current research on the topic demonstrates that nurse-led stroke teams increase hospital adherence to time-sensitive metrics put in place by the American Heart Association (AHA) and improve compliance with quality indicators imposed by regulatory bodies (Heiberger et al., 2019). Nurses are also considered pivotal members of the acute stroke team for their ability to rapidly assess, triage, and promote the smooth, appropriate flow of patients through the health system (Middleton et al., 2015). Based on this data, the proposed Stroke Navigator role was expanded to include involvement with the stroke team to improve acute stroke management as well as providing both education and emotional support.

Theoretical Framework and Implementation Framework

Because smoothing of care transitions from the hospital to the community is an important tenet of improving stroke outcomes, the Transitional Care Model (TCM) was selected to guide the evolution of the proposed project. The TCM was developed to address the high incidence of poor outcomes in medically complex patients. According to Hirschman et al. (2015), these problems can be resolved through early identification of high-risk patients, personalized care management, establishment of trusting patient/caregiver relationships, patient engagement, education regarding disease process and self-care, and caregiver collaboration (See Appendix B,

Figure 1). These interventions, when systematically implemented, can achieve seamless continuity of care as the patient transitions from the hospital to home. This model promotes many of the ideas and interventions that the patient navigator role is designed to employ in practice. In addition, the TCM also specifically addresses many of the systemic issues identified at the site that lead to undesirable sequelae in the targeted patient population.

The Plan Do Study Act (PDSA) framework was chosen to organize the planning and implementation process of the proposed quality improvement project (see Appendix B, Figure 2). Developed by the Institute for Healthcare Improvement (IHI), this framework promotes developing process change in a systematic manner, implementing change quickly on a smaller scale, and revising interventions as needed before broader implementation occurs (Institute for Healthcare Improvement, 2020). Because the project site was a large, academic, fiscally conservative hospital who is aiming to achieve comprehensive stroke designation, it was deemed pertinent to utilize a framework that would promote continuous cost and benefit analysis as well as evaluation of the intervention's impact on trended quality metrics. The first PDSA cycle was based on delivery of an in-person intervention to patients diagnosed with stroke as well as their family members. During this initial cycle, Covid-19 became an increasingly dangerous phenomenon that led to restriction of hospital visitation. This prompted the co-investigators to launch cycle two, which augmented the project's interventions so that they could be delivered to family members in a virtual format. This included revision of educational materials to better suit an online platform as well as utilization of handheld technological devices that would allow face to face discussion across distance. During cycle two, these virtual interventions were only delivered to family members when the patient could not speak or understand the information being presented. However, it was discovered that patients who appeared to have fluent speech

and comprehension were often not able to demonstrate acceptable understanding of all educational topics by the time of discharge. This prompted the third and final PDSA cycle which incorporated utilization of virtual platforms with all patients regardless of lack of disability. In this cycle, the Stroke Navigators met with alert, oriented patients in person while family was present on a virtual platform. Using this technique allowed simultaneous delivery of education to both patients and family members. This ensured that any education not comprehended by the patient would be grasped by close family members who would be instrumental in aftercare. Additionally, the new methodology appeared to improve patient motivation and morale as it increased the frequency of interaction with loved ones.

Methods

This project was considered to pose minimal risk to participants and there was no chance for harm above and beyond what may be endured during the normal course of hospitalization from stroke. As a result, the achievement of applied consent was deemed appropriate for patients to become subjects in this project. There were no overt ethical considerations as the project did not aim its intervention at vulnerable populations. Great care was dedicated to the collection and utilization of patient data. Lists of participants that included patient-specific MRNs were stored on site in a secure, password-enabled, encrypted database that could only be accessed by the project co-investigators. The project's protocol was submitted to the Arizona State University's Institutional Review Board on July 23, 2020 and achieved approval on September 8, 2020.

The chosen site for the Stroke Navigator intervention was a 556 bed, primary stroke center in central New Mexico which had recently applied for comprehensive stroke designation. The population targeted by this study was adult patients over the age of 18 diagnosed with either ischemic or hemorrhagic stroke. Other inclusion criteria included the ability to read and

understand English. Pediatric patients were excluded from this study. For patients not able to communicate effectively or understand language, family members or caregivers became the primary recipients of the intervention. The total sample included 52 patients diagnosed with ischemic stroke (n=28), intraparenchymal hemorrhage (n=11), and subarachnoid hemorrhage (n=9). The remainder of the sample was comprised of patients who presented with conditions that mimic stroke (n=4). Other patient demographic data tracked were age, race, and race (see Appendix C).

The Stroke Navigator project deployed a variety of specific interventions using a three-phase design. The first phase was referred to as the hyperacute phase and spanned from initial Emergency Department presentation until the patient had received hospital unit disposition. Interventions during this phase included collaboration with the stroke team to ensure expedition of care and strict adherence to national stroke guidelines. Phase one began when notification was received of a potential stroke patient inbound to the ED. A secure communications platform entitled Tiger Connect was utilized to receive this information. Each patient was met in the ambulance bay or elevator by the helipad and ushered directly to the radiology suite for rapid CT. If intravenous access was needed for contrasted imagery or if the patient required resuscitative actions due to clinical instability, the Navigator independently delivered these interventions. The Navigator also acted as a critical point of family contact in the setting of current visitation restrictions due to the current pandemic. This aided in the gathering of information pertinent to care provision and obtaining consents for treatment. It also served to keep the family abreast of any changes, test results, and planned procedures. The Navigator remained with the patient delivering routine care throughout phase one and was immediately available to give alteplase to potential candidates. The second phase, termed the acute phase,

began at the time the patient was admitted to a hospital unit and terminated seventy-two hours post admission. This phase focused on emotional support, orientation to the hospital environment and predicted hospital course, as well as initiation of education. During this phase, the education delivered generally focused on yielding patient and family understanding of the stroke diagnosis as well as clinical rationale for care plans. In addition, each participant was given a curated folder of information developed by the Stroke Navigators. This included a carefully-designed booklet outlining community resources for individuals diagnosed with stroke, a tip sheet that guided the individual through the process of applying for financial assistance, a blank notebook that could be utilized to take notes or participate in journaling, and an educational pamphlet focusing on either ischemic or hemorrhagic stroke. The third phase, termed the pre-discharge phase, began at seventy-two hours post admission and continued until discharge. The Navigator responsibilities during this time included performing informal needs assessments which, in turn, allowed appropriate community resource referral. Education was systematically delivered using teach-back method and focused on patient empowerment as well as teaching self-care practices that would serve to mitigate the risk of recurrent stroke. Additionally, the Navigator ensured that all appropriate referrals were in place, appropriate discharge medications were ordered, and follow-up appointments were organized prior to discharge. Patients were enrolled in the study at any phase of the intervention. The demographics table outlines how many patients were enrolled in each phase (see Appendix C).

The data utilized to evaluate this project was already being gathered on a continuous basis by the site's stroke data abstractor. The Stroke Navigator program was designed as a QI project that utilized a pretest posttest design to demonstrate effectiveness of the intervention. First, two groups of de-identified, aggregate data describing hospital adherence to time sensitive

measures were collected for comparison. The first set of data represented the three months preceding the intervention, and the second group represented the three months during which the intervention was deployed. The specific time sensitive metrics selected for analysis include the times from door to CT, from door to needle (alteplase administration), and from door to puncture (initiation of invasive, mechanical thrombectomy). It is important to note that while the Stroke Navigators were often involved in expediting patients to CT, only one case of alteplase administration was encountered during a Navigator shift and no cases of mechanical thrombectomy were encountered. While it was understood that the intervention would have no effect on these variables, the data was analyzed to enable better understanding of general performance trends during the time surrounding the intervention. The resulting data was not normally distributed, so Wilcoxon signed rank tests were utilized to analyze these two large groups of data representing two different time periods. This analysis was able to compare variables during two time frames, but because the stroke navigators were only on site two days per week and only worked with a small fraction of all stroke patients in the data set, a second statistical analysis was performed to better elucidate the impact of the intervention. This analysis compared the hospital's baseline door-to-CT times to the door-to-CT times achieved in the small subgroup of patients who were accompanied by the Stroke Navigators throughout the acute phase of hospitalization. A two tailed Wilcoxon signed rank test was conducted to examine differences between these two groups. Intellectus was utilized for all data analysis and an alpha value of 0.05 was selected to indicate significance. Additionally, a project budget was developed to reveal a cost-benefit analysis of the Stroke Navigator intervention (see Appendix D).

Results

For analysis purposes, the variables associated with door to CT, alteplase, and mechanical thrombectomy times during the three months prior to deployment of the Stroke Navigator project were labeled CT standard, TPA standard, and Thromb standard. The same variables associated with the three months during which the intervention was in progress were termed CT intervention, TPA intervention, and Thromb intervention. As previously described, the co-investigators understood that the Navigator intervention would not affect alteplase or thrombectomy times as there was no or almost no engagement with these processes. These variables were analyzed first to identify systemic trends. For door to alteplase administration, the mean pre-intervention time in minutes was 37.31 (SD = 18.53) and the mean intra-intervention time was 39.92 (SD = 10.17). This did not represent a significant change between time periods (p = 0.576). For door to mechanical thrombectomy, the mean pre-intervention time in minutes was 86.77 (SD = 45.54) and the mean intra-intervention time was 96.23 (SD = 40.95). Again, there was significance between compared data sets (p = 0.583). However, an appraisal of descriptive statistics reveals that hospital performance in these two domains was slightly worse during the three months that the Stroke Navigator project was implemented. This could likely be explained by a variety of factors including the impact of Covid-19 on ED processes or random variation. Descriptive statistics further describing alteplase and thrombectomy times can be found in table 1.

Table 1

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skewness	Kurtosis
TPAintervention	39.92	10.17	13	2.82	23.00	55.00	-0.25	-1.20
TPAstandard	37.31	18.53	13	5.14	17.00	78.00	0.77	-0.27

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skewness	Kurtosis
Thromintervention	96.23	40.95	13	11.36	41.00	198.00	1.06	0.95
Thromstandard	86.77	45.54	13	12.63	18.00	195.00	0.77	0.58

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Door to CT times underwent the same statistical analysis and revealed statistical findings that followed the same trend as was identified for both alteplase administration and mechanical thrombectomy timing. The pre-intervention sample revealed a mean time in minutes of 28.54 (*SD* = 19.38), while the intra-intervention group had a mean time of 30.69 (*SD* = 21.47). Again, no statistical significance was appreciated ($p = 0.366$) and hospital performance again appeared to decline slightly during the intervention period. However, it was noted that the relatively small sample of patients treated by the Stroke Navigator during the three months in question was not enough to show an impact in the intervention group when viewed as a whole. For this reason, an additional test was applied to compare the control group to the smaller group of patients who were accompanied through the ED course by the Stroke Navigator. The new subgroup was labeled SNwithpt_ct. A subsequent analysis revealed a mean door-to-CT time in minutes of 18 (*SD* = 15.53). This demonstrated a significant reduction in door-to-CT time when compared with the pre-intervention group mean time ($p = 0.015$). Descriptive statistics further describing CT times can be found in table 2.

Table 2

Summary Statistics Table for Interval and Ratio Variables

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skewness	Kurtosis
CTintervention	30.69	21.47	112	2.03	2.00	83.00	0.80	-0.18
CTstandard	28.54	19.38	112	1.83	3.00	85.00	1.04	0.34
SNwithpt_ct	18.00	15.53	10	4.91	2.00	45.00	0.82	-0.74

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Important clinical significance was achieved through the three-month implementation of the Stroke Navigator program. Most notably, the hospital was able to achieve comprehensive stroke designation and is now the only hospital in the state to have earned this status. During the live audit in which the Joint Commission (TJC) was evaluating the project site for comprehensive designation suitability, the Stroke Navigators were given the opportunity to present the intervention. In a post-audit debriefing during which comprehensive stroke designation was granted, the TJC auditors praised the Stroke Navigator program as an innovative solution to improving stroke care and urged the hospital to adopt it as a permanent role. Stroke department leaders have attributed the hospital's important achievement to the Stroke Navigator intervention. Hospital administration immediately saw the value in the role and will be hiring three permanent Stroke Navigators that will serve the hospital for the foreseeable future.

Although it was desired to determine the impact of phases II and III of the Stroke Navigator intervention on hospital readmissions and patient satisfaction, this was not feasible. Likely due to Covid-19-induced complexity, the project site's quality department was not able to collect and disseminate the requested data by the time the project had concluded. This data will be trended in the future to determine impact of the work of the permanent Stroke Navigators.

Discussion

The results of this study were in concurrence with previous work that reveals improved hospital performance through utilization of patient navigator programs. The Stroke Navigator role expanded upon the traditional PN concept by placing the Navigator at the patient's side during the acute phase of hospitalization. This was supported by recent evidence showing expedition of acute stroke interventions via implementation of nurse-led stroke teams. Data analysis demonstrated that the Stroke Navigators' work resulted in a reduction of door-to-CT

times by more than 10 minutes in the patients who received the intervention. This is an important finding because the attainment of computed tomography is arguably the most important step of acute stroke care. CT findings dictate all further actions of the stroke team. In the absence of this pertinent imagery, no other critical interventions such as alteplase administration or mechanical thrombectomy can even be considered.

This study had several strengths. One significant strength was that the project supported the hospital during a global pandemic and allowed for the delivery of quality stroke care during a time of increased complexity. This led to the achievement of comprehensive stroke status designation despite Covid-19 presenting major obstacles to success. Another identified strength was the ability of the co-investigators to collect a large body of quantitative data that revealed not only the impact of the intervention, but also revealed systemic trends that will guide future practice improvement. Several weaknesses were also identified. First, the Stroke Navigators were only able to deliver the intervention two days a week. This limited the amount of impact that could be achieved and did not allow for the extension of the intervention to every stroke patient. The small sample size could not produce significant results when a true pre/post study analysis was conducted. Another weakness is that the Stroke Navigators, by chance, were not on site when alteplase or thrombectomy candidates presented to the ED. This resulted in a lack of usable data. Additional research is recommended to determine if the intervention would have a positive impact on these variables. Lastly, data was not available to determine the impact of the Stroke Navigator role on hospital readmissions and patient satisfaction.

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Appendix A

Evaluation and Synthesis Tables

Table 1

Evaluation Table Quantitative Studies

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement / Instruments	Data Analysis	Findings/ Results	Level/Quality of Evidence; Decision for Practice/ Application to Practice
Ali-Faisal, S.F. et al. (2016) **Funding:** Author states no receipt of grant from funding agencies in public, commercial, or not-for-profit sectors **Bias:** None identified **Country:** USA	Andersen Healthcare Utilization Model (Inferred)	**Design:** MA of RCTs **Purpose:** Employ meta-analysis of existing data to determine what effects PN has on healthcare utilization outcomes when compared to usual care	**N:** 25 **Databases Searched:** MEDLINE, PsycINFO, EBM Reviews-Cochrane Central Registrar of Controlled Trials, Cochrane Database of Systematic Reviews, Healthstar, Joanna Briggs Institute EBP	**IV:** Utilization of a PN to improve healthcare utilization and/or patient outcomes **DV1:** Health screening behaviors **DV2:** Attendance of care events (Rehab, or other prescribed treatments)	No specific tools/instruments specified. PRISMA recommendations used to guide MA development	CI and OR used to describe RCT outcome measures, I^2 to evaluate heterogeneity, Egger's regression to test publication bias, study quality grading applied and tested using 2-	**DV1:** PN increased likelihood of patient access to health screening: OR 2.48, 95% CI 1.93-3.18, $p<0.00001$ **DV2:** PN increased likelihood that patient would attend care event: OR 2.55, 95% CI 1.27-5.10, $p=0.008$	**LOE:** I **Strengths:** Properly designed MA with use of high-quality studies, appropriate inclusion/exclusion criteria and appropriate analytic methodology. Use of forest plots further elucidated study results and authors deliver a clear, concise discussion of MA results. **Weaknesses:** PN interventions varied from study to study so it may be difficult to determine which interventions were most effective. Majority of patients were female or from minority

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			Database, Embase **Inclusion Criteria:** RCT with comparison group, term navigation or a variant appeared in description of intervention, study tested PN intervention, measured intervention components, and assessed a health outcome, published in peer-reviewed journal, available in English language **Exclusion Criteria:** Studies that were quasi-experimental, qualitative, case studies, articles which were	**DV3:** Follow up treatment adherence **DV4:** Diagnostic resolution		tailed α of 0.05	**DV3:** PN increased likelihood that patient would attend follow up treatment: OR 2.53, CI 95% 1.02-6.30, p=0.05 **DV4:** No significant effect of PN on likelihood of obtaining diagnostic resolution: OR 1.57, CI 95% 0.85-2.88, p=0.15	ethnic groups. It cannot be determined how the PN intervention would affect other populations. Heterogeneity is considerable for all investigated variables. **Conclusions:** MA of RCTs shows promise in several areas regarding the use of PN interventions in improving necessary utilization of available health services in those with chronic disease. The bulk of studies analyzed feature the effect of PNs on cancer patients; however, the intervention may also be successful in stroke patients.

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			MAs, SRs, comments, editorials, conference proceedings, case series, notes, non peer-reviewed publications, articles using non-human navigators					
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/ Application to Practice**
Balaban et al. (2015) **Funding:** The study was funded by the Agency for Healthcare Research and Quality **Bias:** None identified **Country:** USA	Transitional Care Model (Inferred)	**Design:** RCT **Purpose:** Determine the effectiveness of a PN intervention in reducing 30-day readmission rates in underserved, safety-net patients who suffer from multiple comorbidities	**N:** 1510 **n:** 585 (EG) **n:** 925 (Ctrl) **n:** 1009 (>60 years old) **n:** 501 (≤60 years old) **Setting:** Two hospitals within Cambridge Health Alliance in Massachusetts, a system with ethnically diverse and traditionally	**IV:** Use of a PN program in which patients EG patients received hospital visits and post-discharge outreach calls for the duration of 30 days **DV 1:** In-network, all cause hospital readmission to	Charlson Comorbidity Index used to determine medical complexity of subjects in both Ctrl and EG. Inter-rater reliability (κ = 0.74 to 0.945), good test re-test reliability (α 0.91 to 0.92) 30 day readmissions, primary care	Chi-square analysis, t-tests, logical regression. Intention to treat analysis performed and subgroup analyses performed according to Medicare enrollment status	Statistically significant reduction in hospital readmissions with use of PN intervention and increased outpatient visits within both 7 and 30 days post discharge in patients older than age 60 **DV 1:**	**LOE:** II **Strengths:** RCT design with proper randomization, appropriate stratification by age group to appreciate age-dependent variances in intervention effect, proper adjustment of study results based on gender, language, race/ethnicity, readmission risk factors, comorbidities, behavioral health issues **Weaknesses:** Blinding not feasible for study so some bias is possible even though not asserted, control and

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			underserved patient populations **Sample Demographics:** <u>Ctrl Group:</u> Mean age: 63.7 (SD 16.7); Female gender 59.2%; Race: White 57.5%, Black 15.6%, Hispanic 16.3%, Other 10.6% <u>EG:</u> Mean age: 66.4 (SD 15.5); Female gender 55.2%; Race: White 57.6%, Black 16.1%, Hispanic 14.7%, Other 11.6%	any hospital service within 30 days of discharge **DV 2:** Attending a primary care appointment within seven days of discharge **DV 3:** Any outpatient or ED visit within 30 days of discharge	encounters within 7 days of discharge, and primary care encounters within 30 days of discharge tracked throughout duration of intervention		Readmissions in age 60+: 4.1% decrease, [95% CI -8.0, -0.2], $p < 0.05$ Readmissions in age ≤ 60: 11.8% increase, [95% CI 4.4, 19], $p < 0.05$ **DV 2:** All ages: 5.1% increase in PCP follow up visits within 7 days [95% CI 0.6, 9.6], $p < 0.05$ **DV 3:** All ages: 4.9% increase in PCP follow up visits within 30 days [95% CI 0.9, 8.9], $p < 0.05$ Age 60+: 6.7% increase in PCP follow up visits within 30 days [95%	intervention groups not equal in size, intervention not equally distributed to each subject in intervention group, study places focus on underserved populations and may not be applicable to other populations **Application to Practice:** The study intervention shows promise in preventing 30 day all cause readmissions in medically complex individuals in vulnerable SES subgroups. However, the intervention only demonstrated positive outcomes in individuals older than 60 years as it actually increased readmissions in individuals 60 years or younger. More research is needed to determine if patient navigation is appropriate for younger patients.

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							CI 2.0, 11], $p <$ 0.05	
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/ Application to Practice**
Balaban et al. (2017) **Funding:** The study was funded by the Agency for Healthcare Research and Quality **Bias:** None identified **Country:** USA	Transitional Care Model (Inferred)	**Design:** RCT **Purpose:** To examine the effectiveness of a 30 day PN intervention on hospital-based utilization (ED visits and inpatient admissions) as well as primary care services utilization in high-risk, medically complex patients over 180 days post discharge	**N:** 1921 **n:** 739 (EG) **n:** 1182 (Ctrl) ***Only 79.9% of subjects in EG and 64.8% of subjects in Ctrl group could be followed for 180 days post discharge** **Setting:** Ethnically and linguistically diverse, underserved patients in Cambridge Health Alliance including two hospitals, three EDs, ten community health centers	**IV:** Use of a PN intervention in which navigators provide hospital visits and weekly phone calls post discharge for 60 days **DV 1:** Hospital-based utilization over 180 day period post discharge **DV 2:** Admissions during 180 day period post discharge **DV 3:** Outpatient visits over 180	No specific tool utilized. ED encounters, hospital admissions, and primary care encounters tracked during study period	Estimated propensity scores and inverse probability weights used during randomization process. Data analysis by chi-square tests, *t*-tests, non-parametric tests. GEE models with negative binomial distribution and inverse probability weights to model	As with researcher's previous study, the intervention has positive, clinically significant effects only on subjects over the age of 60 years (reduced hospital usage, increased PCP utilization) **DV 1:** <u>Age 60+</u> Percent change: -18.7, [95% CI -0.41, -0.01], p = 0.038 <u>Age < 60</u> Percent change: 31.7, [95% CI 0.14,	**LOE:** II **Strengths:** Well-designed RCT, appropriate methods of randomization, proper adjustment of results based on gender, language, race, comorbidities, chronic behavioral health issues, etc., fairly large sample size, utilization of tables and graphs to express subject demographics and study results. **Weaknesses:** Blinding not feasible for study creating potential for bias, ctrl and EG not equal in size, readmissions only tracked within one hospital system, cannot account for readmissions out of network, researchers not able to track all patients across entire 180 study duration due to subjects being lost to follow up for unstated reasons, subjects

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			Demographics: Ctrl Group age 60+: Mean age 75.1, Gender: 61.3% female, Race: White 61.5%, Black 16.4%, Hispanic 11.5%, Other 10.5% Ctrl Group under age 60: Mean age: 45.7, Gender: 52% female, Race: White 61.2%, Black 11.2%, Hispanic 20.8%, Other 6.9% EG age 60+: Mean age 74.5, Gender: 57.8% female, Race: White 64%, Black 14.9%, Hispanic 9.9%, Other 11.2% EG under age 60: Mean age 46.2, Gender: 49% female, Race: White 58.2%,	day period post discharge		outcome rates	1.45], p = 0.017 **DV 2:** Age 60+ Percent change: -12.6, [95% CI -0.18, 0.03], p = 0.188 Age < 60 Percent change: 41.0, [95% CI 0.04, 0.55], p = 0.024 **DV 3:** Age 60+ Percent change: 6.8, [95% CI -0.23, 1.11], p = 0.197 Age < 60 Percent change: 10.6, [95% CI -0.46, 2.17], p = 0.202	underserved and ethnically diverse so results may not be applicable to other populations. **Application to Practice:** Like with the author's previous research, results show a clinically significant positive impact on reduction of hospital system utilization and readmissions for medically complex patients over age 60 after hospital discharge. The study also reinforces earlier findings that use of nurse navigation may increase hospital admissions in younger individuals. More research would need to be evaluated to ensure that the intervention does not cause harm in subjects under age 60.

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			Black 12.9%, Hispanic 21.1%, Other 7.7%					
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/ Application to Practice**
Deen et al., (2018) **Funding:** Not stated **Bias:** None identified **Country:** USA	Cancer Navigation Model & Dorothea Orem's Self-Care Deficit Nursing Theory (Stated)	**Design:** Observational Longitudinal cohort study **Purpose:** Examine effect of a NN program on patient adherence post discharge as well as quality of life, functional status, and hospital readmission	**Phase I** **N:** Group A 73, Group B 69 for dysphagia **N:** Group A 51, Group B 50 for discharge on Statin **N:** Group A 68, Group B 68 for stroke education before discharge **Phase II** **N:** 61 **Setting:** Both acute care and post-hospital setting at a primary stroke center	**Phase I** Group A: **IV:** None **Observed variables:** Dysphagia Screening, statin at discharge, stroke education before discharge Group B: **IV:** Employment of a stroke NN program **DV 1:** Dysphagia screening **DV 2:** Statin at discharge	Chart review performed for **DV**s dysphagia, statin at discharge, stroke education, ED visits, readmissions Patient self-report Obtained for **DV**s Medication adherence, physician follow up, smoking **BI** for functional status (α 0.87 to 0.92) **QoL** for quality of life (α 0.82 to 0.92)	Chi-square analysis, ANOVA, *F*-test	Use of a stroke NN program improved outcomes pertaining to several dependent variables: **Phase I** **DV 1:** χ^2 = 17.04 ($p <$ 0.001) **DV 2:** χ^2 = 0.73 (p = .394), no statistical significance **DV 3:** χ^2 = 11.38 (p = 0.001) **Phase II** **DV 1:** Compliance	**LOE:** IV **Strengths:** Well-designed cohort study, appropriate use of analytical tools, detailed discussion of intervention, tables used in data presentation **Weaknesses:** High attrition rate, small final sample size, homogenous sample with possible poor applicability, use of too many dependent variables, use of convenience sample **Application to Practice:** Routine dysphagia screening, stroke teaching before discharge, medication adherence, adherence with physical follow up appointments, functional status, and quality of life were all improved with a

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			Demographics Phase I: Group A was 53% male, 47% female, average age 69.8. Group B was 49% male, 51% female, average age 71.2 Phase II: Over half were male, age range 31 to 86 with mean of 65.3. Predominantly Caucasian from affluent community	**DV 3:** Stroke education before discharge **<u>Phase II</u>** **IV:** Employment of a stroke NN program **DV 1:** Medication adherence **DV 2:** Physician follow up adherence **DV 3:** ED visits **DV 4:** Smoking **DV 5:** Functional status **DV 6:** **QOL** **DV 7:** Readmissions			96.7% at 30 days, 95.1% at 3 months, 98.4% at 6 and 12 months **DV 2:** Physician follow ups in 98.4% of subjects at 7 days, 100% at 3 months **DV 3:** Highest number of stroke visits within first 3 months post discharge **DV 4:** Pre stroke, 21.3% of subjects smoked, 1.6% smoked at 7 days, 3.3% smoked at 3 months, 4.9% smoked at 12 months **DV 5:** $F = 8.12$, $p <$ 0.001 **DV 6:** Mobility ($F =$	stroke navigator intervention. This shows promise for application to practice, but more research is necessary to determine if study findings are applicable to stroke patients in other ethnic or socioeconomic groups.

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							4.91, $p <$ 0.001); Self-Care ($F = 6.53$, $p < 0.001$); Usual Activities ($F =$ 3.21, $p <$ 0.001); no significant difference in pain, anxiety, or depression	
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice/Application to practice**
Di Palo, K. et al., (2017) **Funding:** ACC **Bias:** None identified **Country:** USA	Transitional Care Model (Inferred)	**Design:** Cohort study using retrospective chart review **Purpose:** To determine if the utilization of a PN team comprised of a nurse and pharmacist could serve to improve identification	**N:** 94 **n:** 51 (EG) **n:** 43 (Ctrl) **Setting:** Subjects were selected from 35 hospitals across the United States **Demographics:** EG: Mean age 69.7; female n=22; male n=29,	**IV:** Use of a PN team to increase inpatient education delivery, ensure scheduling of follow up appointments, ensure initial and follow up NT-proBNP labs ordered, ensure ACE-I, ARB, or BB	No specific tool was utilized to measure outcomes. Severity of HF of all subjects assessed utilizing NYHA criteria.	Descriptive analyses, categorical variables described using frequencies and percentage; continuous variables described using means and SDs; outcomes	Statistically significant improvements in frequency of HF specific education delivery, adherence to 14-day follow up appointments, and evaluation of repeat cardiac biomarker labs to trend disease	**LOE:** IV **Strengths:** This is a well-designed cohort study that evaluates effect of intervention in 35 different medical centers. Unlike single center trials, findings are assumed to be more applicable to the general population. Control and pilot groups had baseline homogeneity which reduces potential for bias.

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		of HF inpatients and reduce 30-day all cause readmission rates	mean EF 36.5%; HFrEF n=35; HFpEF n=14; HFmrEF n=2 Ctrl: Mean age 67.9; female n=19; male n=24; mean EF 46.3%; HFrEF n=20; HFpEF n=22; HFmrEF n=1	prescribed at discharge **DV1:** HF education delivery **DV2:** 14-day clinic follow up **DV3:** NT-proBNP monitoring **DV4:** ACE-I, ARB, or BB at discharge **DV5:** Hospital readmission (30-day, all cause)		analyzed using Chi-square test; medical center data analyzed using *t*-test.	progress accomplished with PN team. Reduction in readmissions trended toward significance. **DV1:** EG 56.5%, Ctrl 23.3%; p=0.0002 **DV2:** EG 68.6%, Ctrl 39.5%; p=0.0044 **DV3:** EG 58.8%, Ctrl 22%; p=0.0002 **DV4:** ACE-I/ARB: EG 85.2%, Ctrl 68.4%; p=0.17. BB: EG 90.9%, Ctrl 75%; p=0.12 **DV5:** PN program resulted in	**Weaknesses:** PN team varied depending on location: Some hospitals utilized only nurse and clinical pharmacist while others incorporated other members of the interdisciplinary team. The intervention may not have been identical from one setting to another. Sample size was small and there was no randomization or blinding. **Conclusions:** PN intervention had profound positive results in terms of increasing patient education, improving adherence to clinic follow-up, and improving laboratory monitoring of disease progression. Presumably, this intervention could have similar positive results when applied to stroke population.

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							15.8% decrease in unplanned readmission rate (p=0.15)	
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/Application to Practice**
Horyna, T.J. et al. (2020) **Funding:** Not stated **Bias:** None identified **Country:** USA	Health Promotion Model (Inferred)	**Design:** Retrospective Cohort study **Purpose:** To determine if employment of an interdisciplinary PN program in high utilizers serves to reduce inappropriate health utilization and related hospital expenses	**N:** 364 (Patients served as their own controls in this study) **Setting:** University Medical Center in Lubbock, TX **Demographics:** Median age: 59; Gender: 62.9% female; Race: 0.5% Asian, 17.9% Black, 47.5% Hispanic, 0.3% Native American, 33.8% White; Insurance: 56.3% Medicare,	**IV:** Use of PN comprised of lay navigators and physician, NP, pharmacist, data coordinator, administrator **DV1:** ED visits per patient/year **DV2:** Hospital admissions per patient/year **DV3:** Cost savings	No specific tools or instruments utilized	Descriptive statistics for demographic data, continuous data evaluated with Shapiro-Wilk test, central tendencies reported as medians with IQR, Wilcoxon Signed Rank for pre/post PN data comparison, nominal data evaluated	**DV1**: ED visits pre-enrollment: Median 3.10, IQR 2.93. ED visits post-enrollment: Median 1.13, IQR 3.21. p<0.0001 **DV2:** Admissions pre-enrollment: Median 1.53, IQR 2.49. Admissions post-enrollment: Median 0.00, IQR 1.78. p<0.0001 **DV3:** Annual cost avoidance with PN	**LOE:** IV **Strengths:** Well-designed cohort study uses patients as their own controls and evaluates pre and post PN intervention. Result is clear cause/effect relationship. Highly diverse sample studied demonstrating effectiveness of intervention in various ethnic groups. Appropriate use of analytic methodology to derive presented data. **Weaknesses:** No randomization or blinding. Study only tracked admissions, ED visits in-network, could not account for health encounters in other health systems. Cost analysis based on average costs rather

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			remainder comprised of Medicaid, Private, Indigent, Veterans			by Chi-square test	program, 1 year: $1,266,573; over three full years: $3,799,719	than actual costs, so data is not exact. **Conclusions:** Study demonstrates that PN program is effective for older adults with two or more chronic conditions and at high risk for disconnect from health care systems. More evidence is required to determine if PN program would be effective in other populations.
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/Application to Practice**
Kitzman, P. et al. (2017) **Funding:** Funded by grant money through the University of Kentucky Center for Clinical and Translational Sciences **Bias:** None identified **Country:** USA	Transitional Care Model (Inferred)	**Design:** Pilot study with case series design **Purpose:** To examine the effect of a novel PN program on smoothing transitions of stroke patients from acute care settings to	**N:** 30 **Setting:** Seven rural, economically distressed counties in one geographic location of Kentucky **Demographics:** Female: n=17, male: n=13, mean age 65 (range 38-88), 70% (n=21)	**IV:** Use of KC³T PN program in care transitions over 11-month period **DV1:** Number and type of stroke-related risk factors **DV2:** Follow-up education provision	No specific tools or instruments utilized	No specific analytical methods specified. Data housed in secure database, presented as de-identified aggregates	**DV1:** 70% of subjects (n-21) found to have 5 or more comorbid diseases. No information provided about effect of IV **DV2&3:** PN provided 214 educational encounters, assisted patients with DME (n=17),	**LOE:** IV **Strengths:** Relatively long study duration, meticulous intervention development, comprehensive discussion of background, significance, internal/external evidence. Focus is on effect of PN with stroke patients thus demonstrating novel research. **Weaknesses:** No defined control for outcome comparison, small study group, significant attrition.

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		rural communities	insured through Medicare	**DV3:** Resources accessed **DV4:** 30-day readmissions and ED visits **DV5:** Compliance with medications, physician visits, rehab visits			insurance enrollment (n=11), medication access (n=13) **DV4:** One subject readmitted (n=1) **DV5:** 92% adherent to medication regimens (n=25); 96% attended outpatient rehab appointments (n=26); 70% attended follow up physician visits (n=19)	Results may not be applicable to general population as setting is one small geographical location. **Conclusions:** Although study has flaws, it features the effect of PN on stroke patients and demonstrates that the intervention can have significant positive outcomes on this population. Additional research is necessary to determine if broader impact can be achieved in featured population.
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/Application to Practice**
McBrien, K.A. et al. (2018) **Funding:** Not stated	Chronic Care Model (Inferred)	**Design:** SR of RCTs **Purpose:** To determine	**N:** 74 **Databases Searched:** MEDLINE,	**IV:** Use of a PN services to determine effects on patient	Risk of bias criteria by Cochrane Effective Practice and Organization	Logistic regression used to explore association	Most studies demonstrated statistically significant positive effect	**LOE:** I **Strengths:** SR demonstrates thorough literature review and extends consideration of

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Bias: Possible publication bias **Country:** Publisher country of origin is USA. Research featured in SR published in various countries.		effectiveness and specific attributes of PNs when compared to standard care by assessing outcomes and processes in patients with chronic illness	EMBASE, The Cochrane Central Register of Controlled Trials, CINAHL, PsycINFO, Social work abstracts, systematic search of reference lists of included studies **Inclusion Criteria:** RCTs evaluating effectiveness of PN, adults and pediatrics that either had or were being screened for chronic disease **Exclusion Criteria:** Studies that did not test a PN program, study designs not considered an RCT, studies featuring	outcomes and processes in chronic disease **DVs:** A multitude of DVs were identified: Primary outcomes included health status, A1C level alteration, viral load in HIV, change in GFR, screening completion, adherence to follow up procedures or appointments, hospitalization or ER visits, patient satisfaction. Secondary outcomes: diagnostic resolution, mental health status, QoL,	or Care Group utilized to assess quality of studies	between program features and statistically significant outcomes. Manual tabulation of primary outcomes. Narrative approach to data synthesis	of PN on studied primary outcomes. No studies found a negative effect of the intervention.	PN intervention to a multitude of chronic disease states. Multiple primary and secondary outcomes evaluated to demonstrate full scope of PN effect. **Weaknesses:** No strong quantitative analysis of identified PN outcomes. Narrative approach to synthesis not thoroughly descriptive. Mixed quality of studies in SR. Variation of techniques used by PN navigator programs = inability to determine which method has best efficacy. Possibility of publication bias. **Conclusions:** While the majority of PN research focuses on cancer care, this SR demonstrates that PN intervention can produce positive outcomes with a wide variety of chronic diseases. This further supports the use of PN in patients with stroke. Further research is necessary to describe which specific PN interventions are most useful in achieving positive outcomes.

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			patients with non-chronic diseases, protocols, systematic reviews	distress, mortality				
Citation	**Theory/ Conceptual Framework**	**Design/ Method**	**Sample/ Setting**	**Major Variables & Definitions**	**Measurement / Instruments**	**Data Analysis**	**Findings/ Results**	**Level/Quality of Evidence; Decision for Practice/Application to Practice**
Rocque, G.B. et al. (2017) **Funding:** Not stated **Bias:** None identified **Country:** USA	Socio-Ecological Model (Inferred)	**Design:** Retrospective cohort study **Purpose:** To determine how PCCP navigation program affects breast cancer patients in terms of Medicare spending, hospital admissions/ ED visits, distress	**N:** 1552 **n:** 776 (PCCP) **n:** 776 (MC) **Setting:** 12 cancer centers (both academic and private) in Alabama, Georgia, Florida, Mississippi, Tennessee **Demographics:** PCCP: Age: Mean 73.8, SD 6.7; Race: 13.8% Non-White, 86.2% White; Cancer stage: 95% I-III, 5% IV	**IV:** *PCCP **DV1:** Medicare spending **DV2:** Hospital admissions/ ED visits **DV3:** Distress levels *PCCP: A lay navigation program targeting geriatric breast cancer patients targeting vulnerable Medicare patients	Adapted version of the Distress Thermometer (α=0.90)	Covariates to match comparison groups, suitability of match assessed using two-sample *t*-tests and chi-square tests. Mean and SD calculated for distress scores.	**DV1:** Average quarterly cost savings of $528/quarter 95% CI (-667, -388), $p<0.001$ for stages I-III. No significant cost savings for stage IV **DV2:** For stages I-IV combined, ED visits decreased by 6% per quarter 95% CI (0.90, 0.98). No significant change in hospitalization rates between groups	**LOE:** IV **Strengths:** Multi-center study with relatively large sample size. Well-designed cohort study with clearly presented methodology and graphic representation to display pertinent findings. Well-matched comparison groups established. Utilization of a well-established navigator program ensures uniformity of intervention disseminated to all PCCP subjects. **Weaknesses:** Cohort study with no blinding or randomization. Sample groups comprised of geriatric, Medicare-utilizing women with breast cancer in southern USA. It is unclear if

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			MC: Mean age: 74.3, SD 6.9; Race: 13.1% Non-White, 86.9% White; Cancer Stage: 94.9% I-III, 5.1% IV **Inclusion Criteria:** Females ≥ 65 with Medicare insurance coverage and breast cancer stage I-IV **Exclusion Criteria:** Patients with HMO coverage				**DV3:** Most patients in PCCP sample reported low distress scores (76%, score 0-3)	study results can be generalized to other populations. **Conclusions:** This is one of few studies to analyze cost benefit of employment of PN programs. Previous research has only focused on benefit in terms of patient outcomes. This demonstrates feasibility of intervention related to health system finances.

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Table A2

Evaluation Table Qualitative Studies

Citation	Theory/ Conceptual Framework	Design/Method Sampling	Sample/ Setting	Major Themes/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence/ Decision for Practice/ Application to Practice
Hudson, A.P. et al. (2018) **Funding:** The Office of the Chief Nursing and Midwifery Officer, Queensland Health **Bias:** None identified **Country:** Australia	Health Promotion Model (Inferred)	**Design:** Qualitative study using semi-structured interviews and thematic analysis **Sampling:** All 29 NNs employed in featured settings were recruited. Study was described to all patients enrolled in NN program, 25 elected to participate **Purpose:** To explore patient and caregiver views in experiencing	**N:** 16 NNs **N:** 25 patients **Setting:** Four hospital and health services in Queensland, Australia **Demographics:** Gender: 36% male, 16% female; Age: 1% under 18, 12% 18-30, 12% 31-40, 24% 41-50, 16% 51-60, 16% 61-70, 16% over 70; Participant group: 48% patient, 52%	**Theme 1:** "Being there for us." **Theme 2:** Nurse navigator role described as advocate, trainer, informant, coordinator, trouble-shooter, personal support **Theme 3:** "Making it their business." NNs facilitated movement through health system	Interviews audiotaped with encryption, transcribed verbatim. Subsequent data anonymized	Inductive inference methodology utilized. Data analyzed by thematic analysis framework; core themes developed. Data coded for ongoing analysis and theme identification	NN delivered personalized care, helped patients navigate complex health system, provided support and trusting relationship, decreased stress while increasing self-efficacy in self-care behaviors	**LOE:** VI **Strengths:** Qualitative study provides rare insight into patient experience of NNs' work. Sample consisted of individuals across the lifespan with various chronic conditions. Concise discussion of emerged themes **Weaknesses:** No production of quantitative data due to qualitative

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		services offered by NN program	caregiver; Residence: 19% metro, 43% semi-metro, 38% rural	**Theme 4:** Resources: Ensuring patient access **Theme 5:** Being active in own healthcare **Theme 6:** "Knowledge is power." **Theme 7:** Having information **Theme 8:** Having options **Theme 9:** Knowing the system **Theme 10:** "Being our compass." **Theme 11:** "Getting a sense of direction." **Theme 12:**				approach. Unable to determine usefulness of NN role in those unable to communicate. Small sample in Australia may not be generalizable to other populations **Conclusions:** Study is successful in demonstrating wide range of benefits of NN intervention from subjective experience. Emerged themes useful in supporting quantitative data on topic

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				Negotiating transitions **Theme 13:** Brining it together/care coordination **Theme 14:** Meeting up: "NN is always there." **Theme 15:** Seeing the whole: Considering psychosocial aspects **Theme 16:** Keeping in touch: Someone to talk to				

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Table A3

Synthesis Table

Author	Ali-Faisal et al.	Balaban et al. (2015)	Balaban et al. (2017)	Deen et al.	Di Palo et al.	Horyna et al.	Hudson et al.	Kitzman et al.	McBrien et al.	Rocque et al.
Year	2016	2015	2017	2018	2017	2020	2018	2017	2018	2017
Design/LOE	MA/I	RCT/II	RCT/II	Cohort/IV	Cohort/IV	Cohort/IV	Qualitative/ VI	Case Series/ IV	SR/I	Cohort/IV
Demographics										
EG Age (Mean)		63.7	Age 60+: 74.5 Age<60: 45.2	Phase I: Grp A 69.8, Grp B 71.2 Phase II: 65.3	69.7	59	Not Specified; Range <18 to >70	65		73.8
EG Gender (% F)		59.2%	Age 60+: 57.8% Age<60: 49%	Phase I: Grp A 47%, Grp B 51% Phase II: < half female	43%	62.9	16%	56.6%		100%
Affluent				X			Not Specified			
Underserved		X	X		X	X	Not Specified	X		X
Diagnosis	Varied	Varied, with significant comorbidities	Varied, with significant comorbidities	Stroke	Heart Failure	Varied	Varied	Stroke	Varied	Breast Cancer
Setting										

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Hospital		X	X		X	X				
Community							X			X
Both Hospital and Community	X			X				X	X	
Sample Size (N) or # of Studies	25	1510	1921	Phase I: Grp A 73, 51, 68; Grp B 69, 50, 68 Phase II: 61	94	364	16 NNs 25 Patients	30	74	1552
PN Type										
Nurse	X			X			X		X	
Layperson	X	X	X						X	X
Multidisciplinary team	X				X	X		X	X	
Key Outcome										
Disease-Specific Screening Compliance	↑			↑	↑				↑	
Medication Adherence	↑			↑				↑	↑	
Appropriate DC Meds Ordered				NS	NS					
Pre-Discharge Education				↑	↑			↑	↑	

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Attendance of follow up appointments	↑	↑	↑	NS	↑			↑	↑	
ED Visits		↓	↓	NS		↓			↓	↓, NS change in rate of hospitalization
Hospitalizations or Readmissions		↓	↓, NS Significant only in >60 grp		NS	↓		↓	↓	
Pt Satisfaction with PN							↑		↑	
Cost Savings						↑				↑

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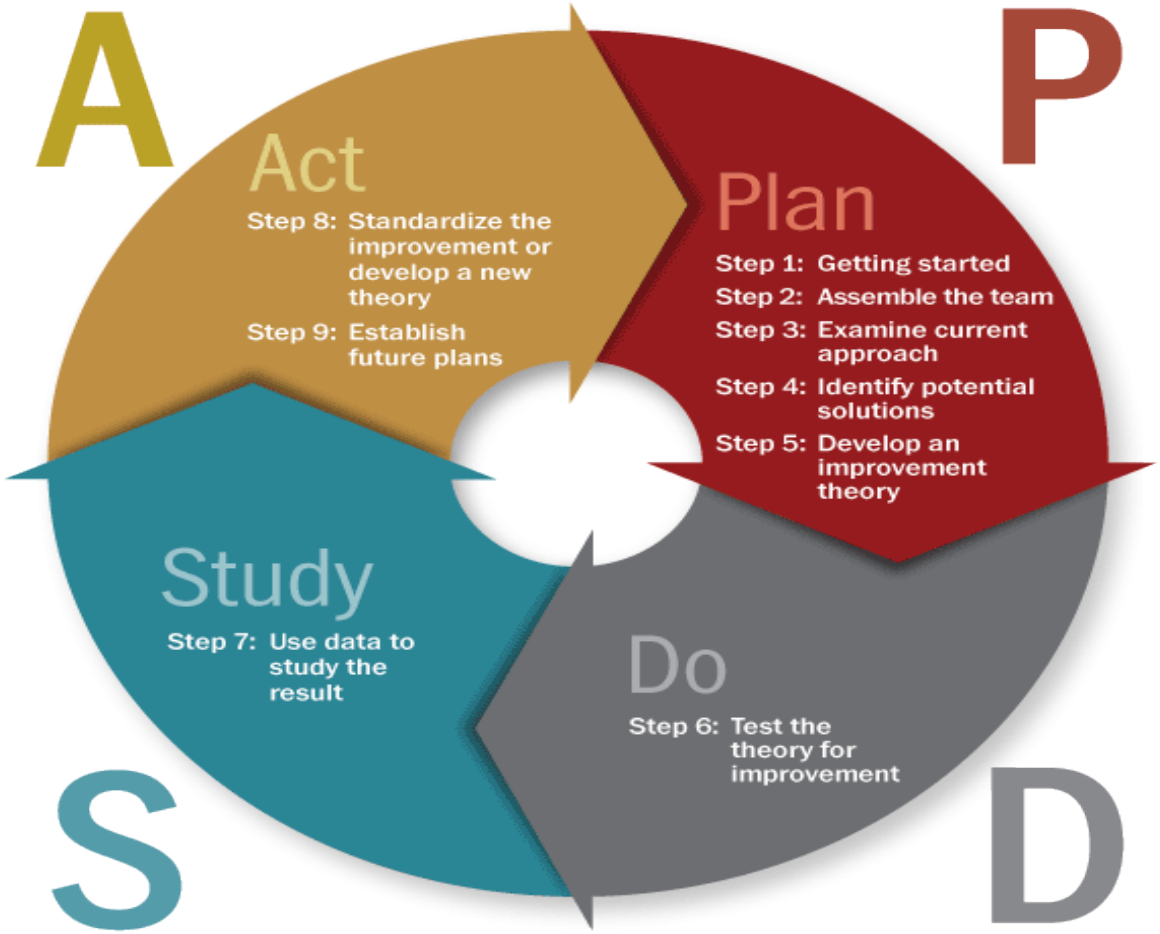
Appendix B

Figure 1

Transitional Care Model

Figure 2

Plan Do Study Act Framework



Appendix C

Table 1

Frequency Table for Nominal and Ordinal Variables

Variable	*n*	*%*
race		
cauc	24	46.15
amerindian	2	3.85
afamer	1	1.92
pacificisland	1	1.92
hispan	24	46.15
Missing	0	0.00
stroketype		
cva	28	53.85
sah	9	17.31
iph	11	21.15
cvaro	4	7.69
Missing	0	0.00
sex		
m	26	50.00
f	26	50.00
Missing	0	0.00
launchphase		
1	10	19.23
2	19	36.54
3	23	44.23
Missing	0	0.00

Note. Due to rounding errors, percentages may not equal 100%.

Appendix D

Table 1

Stroke Navigator Project Budget

Phase	Activities	Cost	subtotal	Total
Preparation				
Direct Costs	Design and print community resource guides for dissemination to patients with stroke (200 @ .10¢/page at FedEx)	$20		
	Print copies of PDF format book, “Families in the ICU: A Survival Guide” for dissemination to stroke patients’ family members (200 copies of 53 page document @ .10¢/page at FedEx)	$1060		
	Folders with attached site logo for dissemination to each stroke patients/family (20 12-count packages @ $17.11/each from Amazon.com)	$342.20		
	Small spiral notebooks for dissemination to stroke patients/family (25 8-count packages @ $9.16/each from Amazon.com)	$229		
	BIC pens for dissemination to stroke patients/family (4 60-	$20	$1671.20	

	count packages @ $5/each from Amazon)			
Indirect Costs	Personal cell contract fees to allow for consistent contact with potential stakeholders and team members	$10		
	Personal internet access to allow for emailing and conducting Zoom meetings with potential stakeholders and team members	$17.50	$27.50	
Delivery				
Direct Costs	Nurse navigator salary (Intervention performed as volunteer hours. No salary received)	$0	$0	
Indirect Costs	Stroke pager usage	$60		
	Company cell usage with Tiger Connect access	$120	$180	
Evaluation				
Direct Costs	Nurse navigator salary paid for time to present project findings to leadership team, stroke team, and two hospital units caring for stroke patients ($36/hour for 4 presentations, 1 hour/session)	$144		
	Review and statistical analysis of study findings	$0	$144	**$2022.70**
Potential Cost Savings				

	Improvement of patient satisfaction scores	$72,000		
	Reduction of 30-day readmissions	$39,804		**$111,804**